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HADDOCK (Melanogrammus aeglifenus)[1/]

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Description and Distribution The haddock (Melanogrammus aeglefinus) is a well-streamlined fish, purplish-gray on its upper portions, and lighter on its belly and sides when fresh from the sea. A member of the cod family, Gadidae, it can be identified best from most of its relatives by the fact that its lateral line (running along either side from head to tail) is dark on a light background rather than light on a dark background, as is the case of the cod and pollock. The presence of a dark shoulder patch, "the devil's thumb-mark," is also a distinguishing characteristic.

Haddock are found on both sides of the North Atlantic, attaining their greatest abundance in the North Sea; off Iceland, Newfoundland, and Nova Scotia; and in the Gulf of Maine including Georges Bank off Cape Cod. Off the American coast they occur generally from the Gulf of St. Lawrence to Nantucket Shoals, south of Cape Cod, although isolated fish have been recorded as far south as Cape Hatteras.

The haddock is strictly a bottom fish, rarely rising from the bottom more than a fathom or two, and inhabits the relatively shallow water of the banks of the continental shelf at depths up to 150 fathoms (900 feet), although the greatest concentrations are found at depths ranging from 20-90 fathoms. Haddock prefer a bottom of smooth, hard sand, gravel, pebbles, or broken shells, in contrast to the cod which may be caught over almost any kind of bottom.

Haddock are white-meated, firm-fleshed fish of mild flavor. Besides being cut into fillets, they are smoked, salted, made into fish cakes and used in fish chowder. Hot smoked haddock is "finnan haddie." They are brought into American ports usually separated into two size categories: (1) scrod, or fish ranging from 1-1/2 to 2-1/2 pounds; and (2) large haddock, fish from 2-1/2 pounds up, which means fish ranging up to 10 pounds, although occasionally larger fish are taken.

1/ Supersedes Memorandum 1-2, issued by the former Bureau of Fisheries

The record haddock for New England waters (Georges Bank) weighed 16-1/2 pounds, was 36 inches long, and was taken in 1941. It was estimated that this fish was 15 years old when caught. An Iceland fish 44 inches long and weighing 36 to 37 pounds has been recorded, and a Horseshoe Ground fish (Nova Scotia) of 38 inches and 18 pounds was taken in 1944.

On the average, fish of 10 inches in length weigh slightly less than 1/2 pound; 20-inch fish weigh 3 pounds 3 ounces; 30-inch fish weigh 9 pounds 14 ounces. The relationship between length and weight of fish "in the round" (ungutted fish) is shown in table 1.

Table 1.--Average fork length in inches, and weight in pounds and ounces, of ungutted haddock.

Length	Weight	Length	Weight
Inches	Pounds and ounces	Inches	Pounds and ounces
8	- 4	21	3 - 10
9	- 5	22	4 - 3
10	- 7	23	4 - 12
11	- 9	24	5 - 5
12	- 12	25	5 - 15
13	- 15	26	6 - 9
14	1 - 2	27	7 - 6
15	1 - 6	28	8 - 3
16	1 - 11	29	9 - 1
17	2 - 0	30	9 - 15
18	2 - 6	31	10 - 13
19	2 - 12		
20	3 - 3		

Life History Haddock in New England waters mature at 3 or 4 years of age, 2 to 3 pounds, in weight (in Newfoundland waters at 4 or 5 years of age), and concentrate for spawning in definite locations at moderate depths where the bottom is usually smooth sand and gravel. The principal spawning grounds in the Georges Bank area are on the eastern part although in some years there is a considerable concentration of spawning fish in South Channel. Spawning occurs during February, March, April and May. The number of eggs produced varies from 150,000 to about 2,000,000 per fish, depending upon the size and age of the female. These eggs are small (about 1/16 inch) and drift with the currents until hatched, in about 2 to 4 weeks. At the time of hatching, the larva is about 1/10 inch long and has a yolk sac containing food attached to its belly. The larva absorbs this food in less than 2 weeks and begins more nearly to resemble a fish, but does not acquire the general aspect of an adult haddock until a length of about 1-1/4 inches is reached. At this size the young can be distinguished from a cod or pollock by the same high first dorsal fin that is a good field mark for adult haddock. The young at this time take to the bottom in search of food and commence their bottom existence. Unlike young cod and pollock, they never are seen in harbors.

Dr. Walford reports that in 1932 some of the eggs spawned on the southwestern part of Georges Bank were carried westward along the southern edge of the bank, while others drifted in a great clockwise eddy, which apparently encircled the whole Georges Shoals region. Thus, while some of these young Georges Bank haddock took to the bottom 100 miles or more from their place of spawning, others began their life on the bottom very near their birthplace. Those that the currents carry out over the great depths probably perish when they attempt to go to the bottom. The principal nursery grounds for young haddock on Georges is the southeastern part. As they grow up into the "scrod" category they move up over the rest of the bank.

As in many other species, it is possible to determine the age of haddock by a microscopic examination of its scales. When viewed under a microscope, a haddock scale appears as a series of concentric rings. These rings are formed wide apart during summer (when the scale and the fish are growing rapidly) and close together during winter (when growth is relatively slow). A year of growth thus consists of a series of widely-spaced rings followed by a series of rings that are close together, and by counting the number of such series, the age usually can be determined with considerable accuracy.

Growth in the first year, during which the young fish remain in the general area in which they went to the bottom, ranges from 5-1/2 to 10-1/2 inches on different parts of Georges Bank, differences depending probably upon relative amounts of food available and the temperature of the water in various locations. As maturity is approached the fish become more migratory and evidently move with the season back and forth over the bank, into South Channel, down onto Nantucket Shoals, and some up along the coast as far as Mt. Desert Island, Me. Average lengths for fish of various ages from Georges, Nova Scotia, and other banks are shown in table 2.

Table 2.--Length in inches attained at the end of the first seven years of life by haddock from various localities

Year	Georges Bank	Nova Scotia	Newfound-land	Iceland	Farce Islands	North Norwegian	North Sea
1	8.1	6.6	6.7	6.5	6.5	7.1	6.7
2	14.5	11.1	10.9	12.0	12.5	11.6	9.6
3	18.3	14.4	14.5	15.6	16.4	14.4	11.6
4	20.2	17.5	17.1	18.9	19.0	17.5	13.2
5	21.1	20.2	19.1	21.7	21.6	20.2	14.6
6	22.4	22.2	20.9	23.8	23.9	21.5	16.1
7	23.9	24.0	22.3	25.2	25.9	23.0	16.9

The food of haddock is varied and includes almost all known invertebrates found on the ocean floor. Some of the more common forms found in haddock stomachs are: crustaceans (like hermit and spider crabs), snails, clams, a great variety of worms, brittle stars, sea urchins, and only rarely fish, and then usually they are small and inactive forms. Most of its food consists of rather slow-moving or buried forms. The haddock's mouth is adpated more for grubbing on the bottom than for pursuing moving organisms.

Information on the migrations of haddock is obtained through growth rate determinations, age and size composition of the catch in various localities, and by fishermen's observations, but principally through tagging fish in known places and observing where these fish are caught.

In past years, numbers of haddock have been tagged at several points along the New England coast. Rewards have been offered for the return of any of the numbered tags that were found by fishermen, together with information as to when and where the fish were caught. Most of the fish that were recaptured were caught close to the places where they were tagged. Some, however, had migrated considerable distances. For instance, some of the fish released in South Channel were recaptured on Southeast Georges Bank, Stellwagen Bank, Platts Bank, and as far north as Grand Manan Island. Some fish tagged near Boothbay Harbor, Me., were recaptured on Platts. Stellwagen, and Georges, and one fish, northeast of Mt. Desert. Fish tagged at Mt. Desert were taken mostly to the southwest, all along the Maine coast, on Platts Bank and Jeffries Ledge, in Massachusetts Bay and South Channel, and on Georges Bank; some to the northeast in the Bay of Fundy; and a limited number in the vicinity of Browns Bank, off Nova Scotia.

Results from such tagging research and from other studies indicate that there is a seasonal migration of haddock from the South Channel area in the springtime north along the Massachusetts and Maine coasts, some fish going as far as the Bay of Fundy. A reverse movement back down along the coast to the South Channel, and from there out onto Georges Bank occurs in the fall and early winter. There is some evidence indicating that small numbers of fish may cross the Fundian Channel which separates Georges and the Nova Scotian Banks at times when temperature and salinity conditions in the channel are suitable for haddock. However, these movements to and from the Georges Bank region affect only a small proportion of the population, so that it appears that the New England population of haddock (Georges, Nantucket Shoals, and South Channel) is largely independent of the Nova Scotian population (Browns, Roseway, LeHave, Sambro, Emerald, Horseshoe, Sable Island, Middle Ground, and Quereau Banks). Data on growth rates and size and age composition of the fish in these two areas support this contention.

In addition to long-range migrations, there appear to be considerable seasonal movements of fish between deeper and shoaly waters on the continental shelf and between various parts of the banks in different seasons of the year. These movements appear to be in search of favorable spawning, feeding, or temperature conditions. Haddock avoid very cold water (colder than 33-34 degrees F) and warm water (warmer than 50-52 degrees F).

In general, during the late winter haddock are to be found in the deeper water of the region within the continental shelf area, which is warmer than the shallower water; while during the summer, in those areas where the surface water temperatures rise above 50 degrees, haddock will be found in the coldest water available, which is again in the deeper locations. During spring and fall they are often in the shallower areas, as these waters warm up from the minimum temperature reached in winter and cool off from the maximum temperature reached in summer.

Magnitude of the Haddock Fishery The haddock is the mainstay of the United States otter trawl fishery, and is the most valuable of all North Atlantic fisheries. In 1929, the peak year for haddock landings, haddock ranked fifth in the United States and Alaska as to total poundage (nearly 260 million pounds) landed, being exceeded only by salmon (a total of 6 species), pilchards, menhaden, and sea herring. In value it ranked third, bringing over 9 million dollars to the fishermen, and being exceeded only by salmon and oysters.

In 1940 haddock ranked fifth in total poundage and fifth in value, being exceeded in poundage by pilchards, menhaden, salmon and mackerel; and in value by salmon, oysters, tuna (total of 4 species) and shrimp in the order named.

The total United States haddock catch in early years was rather stable, ranging between 45 and 90 million pounds from 1880 to 1920. During the 1920's the rapid development of a market for filleted fish and the development of the process of quick freezing greatly increased the demand for haddock and the catch rose to a peak of almost 260 million pounds in 1929. The total catch of haddock taken from North American fishing grounds by United States, Canadian, and European vessels for the years 1918 to 1940, are shown in table 3 together with incomplete records for 1941-45. It can be seen that the catch has declined considerably since 1929. The exact cause of this decline is the subject of study by biologists of the Fish and Wildlife Service at the present time.

About 95 percent of the United States catch of haddock is landed at New England ports. During the early years of the intensive fishery, Boston was by far the leading New England port, but during World War II, New Bedford landed a progressively larger proportion of the total. Of the entire New England catch, 2 percent was landed at New Bedford in 1941, 27 percent in 1945. Boston decreased during these years, having contributed 92 percent of the total catch in 1941 and 54 percent in 1945.

The Georges Bank, South Channel area, extending for 200 miles east of Cape Cod, has been the most productive haddock grounds since the beginning of the United States haddock fishery. In 1930 over 80 percent of the New England catch came from these grounds and about 16 percent from the Nova Scotian Banks. In 1940 these grounds contributed less than 70 percent, and the Nova Scotian grounds about 26 percent. As fish have become scarcer on the nearby Georges Bank grounds, fishermen have been forced to make more trips to the more distant Nova Scotian Banks. This has resulted in increasing operating costs and decreasing quality of fish landed.

Table 3.--Haddock from North American waters landed in United States, Canada, and European countries (in thousands of pounds) 1/

Year	Canada	United States	Europe	Total
1918	70,183	74,800	-	144,983
1919	60,974	100,000	-	160,974
1920	45,500	95,900	-	141,400
1921	26,788	79,500	-	106,288
1922	30,496	87,100	-	117,596
1923	30,487	91,800	-	122,287
1924	34,496	100,000	-	134,496
1925	36,092	113,100	64	149,255
1926	50,276	118,700	167	169,144
1927	43,816	168,400	53	212,269
1928	49,182	217,400	312	266,895
1929	55,904	257,727	1,474	315,105
1930	48,878	237,508	-	286,386
1931	35,985	171,420	279	207,685
1932	35,982	146,065	-	182,047
1933	27,991	145,970	6,081	180,042
1934	35,393	144,500	14,650	194,543
1935	36,585	177,200	458	214,242
1936	39,616	162,700	2	203,318
1937	38,299	155,700	4	194,003
1938	40,500	154,200	-	194,700
1939	42,906	156,600	-	199,506
1940	40,002	136,800	-	176,802
1941 2/	-	159,693	-	-
1942 2/	-	121,722	-	-
1943 2/	-	106,126	-	-
1944 2/	-	119,486	-	-
1945 2/	-	130,813	-	-
1946 3/		136,257		

1/ Data from unpublished manuscript of Wm. C. Herrington.

2/ No records available at the present time for Canada and Europe. United States figures represent landings only at the ports of Boston, Gloucester, and New Bedford, Mass; Portland, Me.; New York, N. Y. and minor Maine ports.

3/ Includes Provincetown and other Cape Cod ports.

Note: Weights are for eviscerated fish.

Conservation Measures The haddock catch has declined considerably since 1929 in spite of improvements in fishing gear. This reduced catch has been the result of an actual decrease in abundance of fish, at least on Georges Bank. In recent years an increasing proportion of the catch has been taken with otter trawls, which have supplanted the line trawls used in the early fishery. In 1919, 57 percent of the haddock catch was taken with otter trawls and 40 percent with line trawls; while in 1940 the proportions had changed to 87 percent by otter trawls and only 13 percent by line trawls. This trend has resulted in the capture of fish at a smaller average size, for otter trawls capture a much higher proportion of small fish than does hook-and-line gear.

Studies by the Fish and Wildlife Service under the direction of Wm. C. Herrington, indicate that the use of larger meshed otter trawls and the adoption of a minimum market size would reduce greatly the proportion of small haddock taken. By protecting baby scrod haddock (fish less than 1-1/2 pounds) until they have finished the period of their most rapid growth, increased abundance and production could be obtained.

It has been found that in years when a small number of adult fish were present on Georges Bank at spawning time, a small production of scrod haddock resulted three years later. Also, in years when a very large number of adult fish was present, the production of scrod three years later was likewise low. In the first case, the trouble seemingly was an insufficient number of eggs produced. In the second case, although a large number of eggs was produced, the competition between the young and the large population of adults resulted in a high mortality of the young before they reached commercial size. In years when an intermediate number of adults was left at spawning time, the production and survival of young was at a maximum.

Present tentative conclusions as to how the yield can be increased and maintained above its present low level need to be tested further, improved in accuracy, and extended to the Nova Scotian Banks, which are now being fished intensively. Research on survival and growth rates under different population conditions, size and age composition of the populations, and abundance of commercial-sized fish, is being carried on at the present time.

BIBLIOGRAPHY

The following mimeographed memoranda related to haddock are available from the Fish and Wildlife Service, U. S. Department of the Interior, Washington 25, D. C.

45 FL Brine-salted cod and haddock
28 S Smoked haddock or finnan haddie
1741 FI Carbon dioxide in handling fresh fish (haddock)

Bigelow, H. B. and W. W. Welsh
1924 Fishes of the Gulf of Maine. U. S. Bur. of Fisheries, Bull. 40, Pt. 1, pp. 432-444.

Carson, R. L.
1943 Food from the sea - Fish and shellfish of New England U. S. Fish and Wildlife Serv. Cons. Bull. 33, pp. 31-34

Duff, Dorothy.
1916 Investigation of the haddock fishery, with special reference to the growth and maturity of the haddock (Melanogrammus aeglefinus). Contr., Canadian Biology, 1914-1915, pp. 95-105.

Fiedler, R. H.
1931 Fishery industries of the United States. U. S. Bur. of Fisheries, App. II to Rept. Comm. Fisheries, 1931, pp.109-552

1943 Fishery statistics of the United States 1940. U. S. Fish and Wildlife Serv., Stat. Dig. 4, 223 pp.

Herrington, W. C.
1933 Conservation of immature fish in otter trawling. Trans. Amer. Fish. Soc. Vol. 62, 1932, pp. 57-63.

1935 Modifications in gear to curtail the destruction of undersized fish in otter trawling. U. S. Bur. of Fisheries, Inv. Rept. 24, 48 pp.

1936 Decline in haddock abundance on Georges Bank and a practical remedy. U. S. Bur. of Fisheries, Fish. Circ. 23, 22 pp.

1941 A crisis in the haddock fishery. U. S. Fish and Wildlife Serv., Circ. 4, 14 pp.

Herrington, W. C.
1944 Factors controlling population size. Trans. No. Amer. Wildlife Conf., 1944, pp. 250-263

Needler, A. B.
1931 The haddock. Biol. Canada; Bull. 25, 28 pp.

Needler, A. W. H.
1930 Statistics of the haddock fishery in North American waters. U. S. Bur. of Fisheries, Doc. 1074, pp. 27-40

1930 The migrations of haddock and the interrelationships of haddock populations in North American waters. Contr. Can. Biol. and Fish., Vol. 6, No. 10, pp. 243-313

Radcliffe, L.
1921 Fishery industries of the United States, 1920. U. S. Bur. of Fisheries, Doc. 908, 187 pp.

Rait, D. S.
1936 The haddock stocks of the northeast Atlantic, 1916-1935. Fish. Bd. Scotland, Scientific Inv. 1936, No. 1, 32 pp.

Ritchie, A.
1937 The food and feeding habits of the haddock (Gadus aeglefinus) in Scottish waters. Fish. Bd. for Scotland, Scientific Inv. 1937, No. 2, 94 pp.

Rounsefell, G. A.
1942 Field experiments in selecting the most efficient tag for use in haddock studies. Trans. Amer. Fish. Soc. Vol. 71, 1941, pp. 228-235.

Saemundson, Bjarni.
1925 On the age and growth of the haddock (Gadus aeglefinus L.) and the whiting (Gadus merlangus L.) in Icelandic waters. Meddeleser fra Kommissionen for Havundersgelser, Serie: Fiskeri. Bind. VIII, 33 pp.

Schroeder, W. C.
1942 Results of haddock tagging in the Gulf of Maine from 1923 to 1932. Jour. Mar. Research, Vol. 5, No. 1, pp. 1-19

Thompson, H.

1923 Problems in haddock biology with special reference to the validity and utilization of the scale theory. I. Preliminary report. Fish. Bd. Scotland, Scientific Inv., 1922, No. V, 78 pp.

1924 Haddock biology. II. Frequency and distribution of the age classes in 1923. Fish. Bd. Scotland, Scientific Inv., 1924, No. 1, 48 pp.

1926 Haddock biology. III. Metabolism of haddock and other Gadoid fish in aquarium. Fish. Bd. Scotland, Scientific Inv., 1926, No. II, 14 pp.

1939 The occurrence and biological features of haddock in the Newfoundland area. Newfoundland Dept. Nat. Resources, Res. Bull. No. 6, 31 pp.

Walford, L. A.

1938 Effect of currents on distribution and survival of the eggs and larvae of the haddock (Melanogrammus aeglefinus) on Georges Bank. U. S. Bur. of Fisheries, Bull. 29, 73 pp.

United States Government publications may be consulted in many public libraries. Those which are not out of print may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.